

We claim:

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2 1 A method of publishing relational data as XML, comprising the method steps of:  
3 mapping a number of relational database tables to a number of virtual XML  
4 documents;  
5 issuing XML queries over said virtual XML documents;  
6 parsing said XML queries;  
7 transforming said XML queries into a language-neutral intermediate  
8 representation;  
9 rewriting said language-neutral intermediate representation into an equivalent  
10 form easily translated into an SQL query;  
11 translating said equivalent form into an SQL query over said relational database  
12 tables and into tagging instructions passed to a tagger;  
13 executing said SQL query to produce SQL query results passed to said tagger;  
14 and  
15 generating XML output using said SQL query results and said tagging  
16 instructions.

1 2. The method of claim 1 wherein said method operates over a distributed computing  
2 network.

1 3. The method of claim 2 wherein said method operates over the Internet.

- 1 4. The method of claim 1 wherein said mapping step operates recursively.
- 1 5. The method of claim 1 wherein said mapping step operates manually.
- 1 6. The method of claim 1 wherein said mapping step maps said relational database  
2 tables to said virtual XML documents in a one-to-one manner.
- 1 7. The method of claim 1 wherein said language-neutral intermediate representation  
2 includes a sequence of operations describing:  
3 how to select and relate data from said relational database tables; and  
4 how to construct and group new XML elements from data bindings.
- 1 8. The method of claim 7 wherein said transforming step operates on at least one said  
2 relational database table and produces at least one output table.
- 1 9. The method of claim 7 wherein said operations include BIND operations.
- 1 10. The method of claim 7 wherein said operations include SELECT operations.
- 1 11. The method of claim 7 wherein said operations include CONSTRUCT operations.

- 1 12. The method of claim 7 wherein said operations include JOIN operations.
- 1 13. The method of claim 7 wherein said operations include GROUP operations.
- 1 14. The method of claim 7 wherein said operations include NEST operations.
- 1 15. The method of claim 1 wherein said rewriting step includes the further steps of:
  - 2 eliminating both S and B whenever S is followed by a BIND operation B, where
  - 3 S denotes the sequence of CONSTRUCT, GROUP, and CONSTRUCT
  - 4 operations following a table access for a default view of a table T,
  - 5 leaving just the table access for T; and
  - 6 replacing N by a JOIN operation, followed by S and a new GROUP operation
  - 7 which performs the child grouping that was previously done by N, where
  - 8 N denotes a NEST operation and S denotes any sequence of
  - 9 CONSTRUCT and GROUP operations for the child input of N.
- 1 16. The method of claim 1 wherein said rewriting step may operate repeatedly for
  - 2 deeper levels of nesting.
- 1 17. The method of claim 1 wherein said tagger operates outside an RDBMS.

1 18. The method of claim 7 wherein said operations describing how to select and relate  
2 data are translated into an SQL query that establishes selection criteria and  
3 required relationships among data.

1 19. The method of claim 7 wherein said operations describing how to construct and  
2 group new XML elements are translated into said tagger instructions.

1 20. The method of claim 19 wherein said operations are reordered to be performed last.

1 21. The method of claim 19 wherein said language-neutral intermediate representation  
2 serves as said tagging instructions.

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1 26. The system of claim 22 wherein said schema mapper operates manually.

1 27. The system of claim 22 wherein said schema mapper maps said relational database  
2 tables to said virtual XML documents in a one-to-one manner.

1 28. The system of claim 22 wherein said language-neutral intermediate representation  
2 includes commands controlling how said system:  
3 selects and relates data from said relational database tables; and  
4 constructs and groups new XML elements from data bindings.

1 29. The system of claim 28 wherein said parser operates on at least one said relational  
2 database table and produces at least one output table.

1 30. The system of claim 28 wherein said system performs BIND operations.

1 31. The system of claim 28 wherein said system performs SELECT operations.

1 32. The system of claim 28 wherein said system performs CONSTRUCT operations.

1 33. The system of claim 28 wherein said system performs JOIN operations.

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1 34. The system of claim 28 wherein said system performs GROUP operations.

1 35. The system of claim 28 wherein said system performs NEST operations.

1 36. The system of claim 22 wherein said rewrite engine:

2 eliminates both S and B whenever S is followed by a BIND operation B, where

3 S denotes the sequence of CONSTRUCT, GROUP, and CONSTRUCT

4 operations following a table access for a default view of a table T,

5 leaving just the table access for T; and

6 replaces N by a JOIN operation, followed by S and a new GROUP operation

7 which performs the child grouping that was previously done by N, where

8 N denotes a NEST operation and S denotes any sequence of

9 CONSTRUCT and GROUP operations for the child input of N.

1 37. The system of claim 22 wherein said rewrite engine may operate repeatedly for

2 deeper levels of nesting.

1 38. The system of claim 22 wherein said tagger operates outside an RDBMS.





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- 1 43. A system for publishing relational data as XML, comprising:
- 2 means for mapping a number of relational database tables to a number of virtual
- 3 XML documents;
- 4 means for issuing XML queries over said virtual XML documents;
- 5 means for parsing said XML queries and for transforming said XML queries
- 6 into a language-neutral intermediate representation;
- 7 means for rewriting said intermediate representation into an equivalent form
- 8 easily translated into an SQL query;
- 9 means for translating said equivalent form into an SQL query over said
- 10 relational database tables and into tagging instructions;
- 11 means for executing said SQL query to produce SQL query results; and
- 12 means for generating XML output using said SQL query results and said
- 13 tagging instructions.

1 44. A computer program product comprising a machine-readable medium including  
2 machine-executable instructions therein for publishing relational data as XML  
3 comprising the steps of:  
4 mapping a number of relational database tables to a number of virtual XML  
5 documents;  
6 issuing XML queries over said virtual XML documents;  
7 parsing said XML queries;  
8 transforming said XML queries into a language-neutral intermediate  
9 representation;  
10 rewriting said language-neutral intermediate representation into an equivalent  
11 form easily translated into an SQL query;  
12 translating said equivalent form into an SQL query over said relational database  
13 tables and into tagging instructions passed to a tagger;  
14 executing said SQL query to produce SQL query results passed to said tagger;  
15 and  
16 generating XML output using said SQL query results and said tagging  
17 instructions.